4.—New finds of sand fulgurites from the Perth Basin, Western Australia

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Abstract

The first fulgurite recorded in Western Australia was recovered from West Popanyinning in 1931. In 1974 fulgurites were recorded from Willetton, East Victoria Park, Canning Vale and near Broome, and they are now reported from Jandakot, Lynwood, Welshpool, Malaga, Beechboro, Upper Swan, Wanneroo, Guilderton and near Northampton. Eleven of the fourteen localities are in the central Perth Basin, and ten are near Perth. The spate of recent finds near Perth is due to close local investigation. Fulgurites are also probably fairly common in the rest of the central Perth Basin, which is similar in its topography and sandy soil, and has about the same annual lightning frequency. The fairly common association of Aboriginal artifacts with fulgurite fragments in sand blow-outs is probably generally fortuitous, because both remain as lag when sand is removed. However, isolated fulgurite fragments do not necessarily post-date associated artifacts.

Introduction

Sand fulgurites are glassy, tube-like bodies fused from sand by lightning on or near the Earth's surface. Reports of fulgurites seen to form from lightning strikes have been presented by Pfaff (1822), Wicke (1859), Van Bastelaer (1883), Wood (1910), Simpson (1931), and Fenner (1949). Beadle (1940) has shown fairly conclusively that bushfires do not attain the temperatures necessary to fuse quartz (Rogers 1946) and thus simulate fulgurites.

Fulgurites generally consist of vesicular lechatelierite with a mean refractive index close to 1.461 ± 0.002, and have a smooth, translucent, vitreous lumen with a rough, opaque, commonly flanged exterior containing embedded quartz grains, or partly fused quartz grains. Most fulgurites recovered recently from Western Australia are fragmentary, probably because of sand movement after the fulgurites formed, and represent parts of tube walls and flanges. The original appearance of the fulgurites can be reconstructed from two that were found *in situ* and unbroken, namely the West Popanyinning fulgurite (Simpson 1931) which was tubular, highly flanged, vertical and about a metre long, and the East Victoria Park fulgurite (Glover 1974) which was tubular, vertical and may have been over two metres long. Tube walls are commonly one or two millimetres thick, and generally contain vesicles with their long axes normal to the surfaces. It has been shown on chemical grounds that fulgurite fragments from Willetton were formed from the fusion of the white sand in which they were found (Glover 1974).

The newly recorded material, which is all fragmentary, is described briefly, and its significance is discussed. The colours and corresponding numerical designations refer to the Rock-color Chart distributed by the Geological Society of America (Rock-color Chart Committee 1963). Each fulgurite fragment, or group of fragments from one locality, has been allotted a number by the Geology Department of the University of Western Australia, with the exception of the Wanneroo object, on loan from the Commonwealth Scientific and Industrial Research Organisation, Floreat Park. The distribution of the fulgurite localities is shown in Figures 1 and 2.

Petrography

General

Most of the fulgurite fragments have been recovered from sand blow-outs, or from commercial sandpits, and because of probable sand movement, their precise stratigraphic position is uncertain. It is clear in some places, however, that they come from about a metre or less below the original surface. Aboriginal artifacts, dominantly quartzite and chert flakes, have been found at ten of the fourteen localities.

The newly recorded material consists mainly of irregularly shaped, crinkled to roughly flat fragments up to 4 cm x 2 cm x 1 mm in size, but there are some tubular fragments up to 4 cm long. One side of each fragment is almost invariably vitreous, translucent, smooth and somewhat mammilated: this side is always the lumen in tubular fragments. The other side is rough, opaque and contains embedded sand grains. The glass is not uniformly coloured even within the one fragment, and the smooth side of the fragments commonly ranges from very light grey (N8) to light grey (N7), but other colours including white (N9), pinkish grey (5YR8/1), greyish orange (10YR7/4), dark yellowish brown (10YR4/2), medium dark grey (N4), and greyish black (N2) have been observed. Dark grey (N3) to black (N1) schlieren about one mm long, or smaller spots, are commonly found in the light-coloured glass. The overall colour of the rough outer surfaces is generally a little different because of embedded sand grains and superficial iron staining.

Under the microscope, some quartz sand grains show cracks filled with glass, or grade

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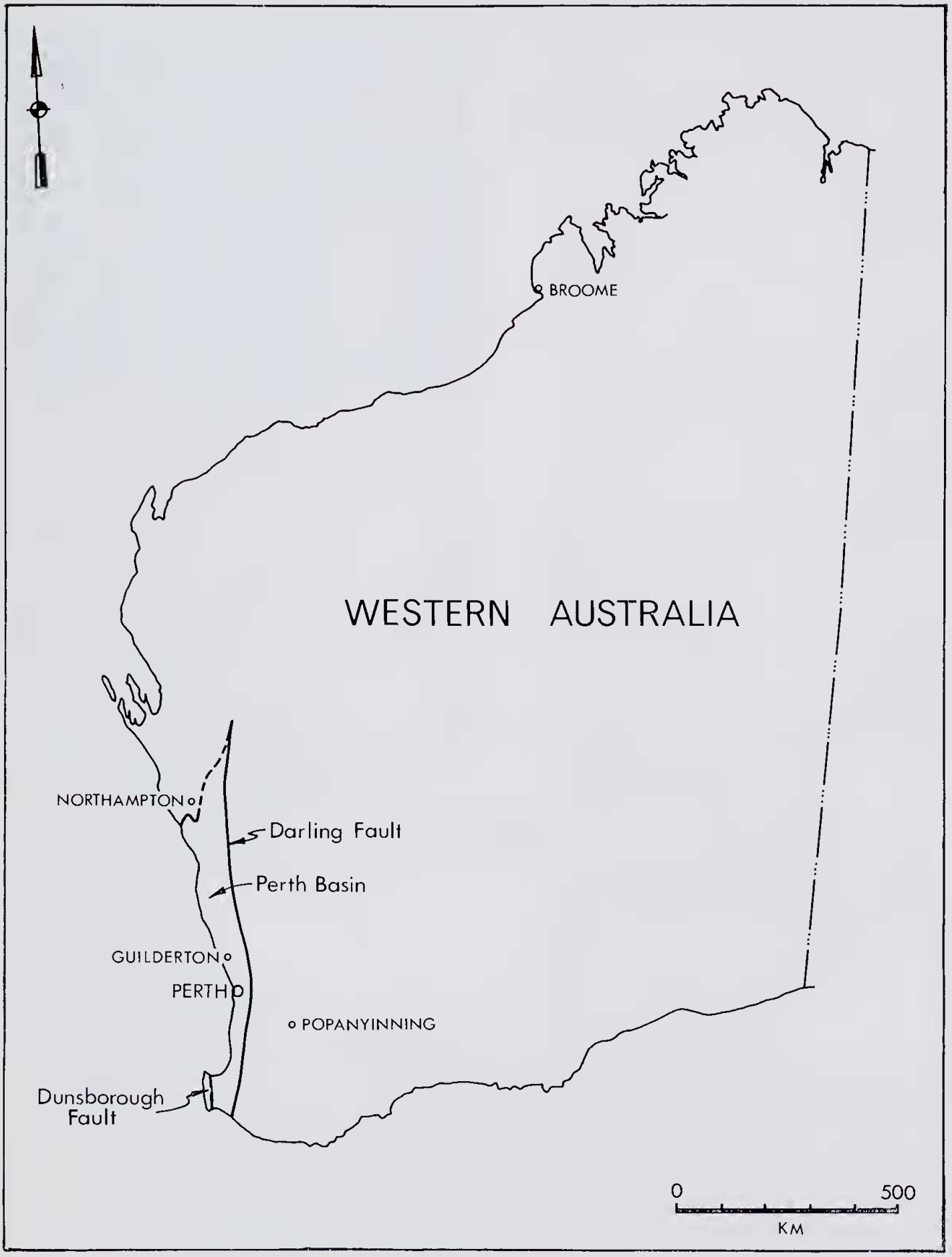

Fig. 1.—Locality map of Western Australia showing Perth Basin.

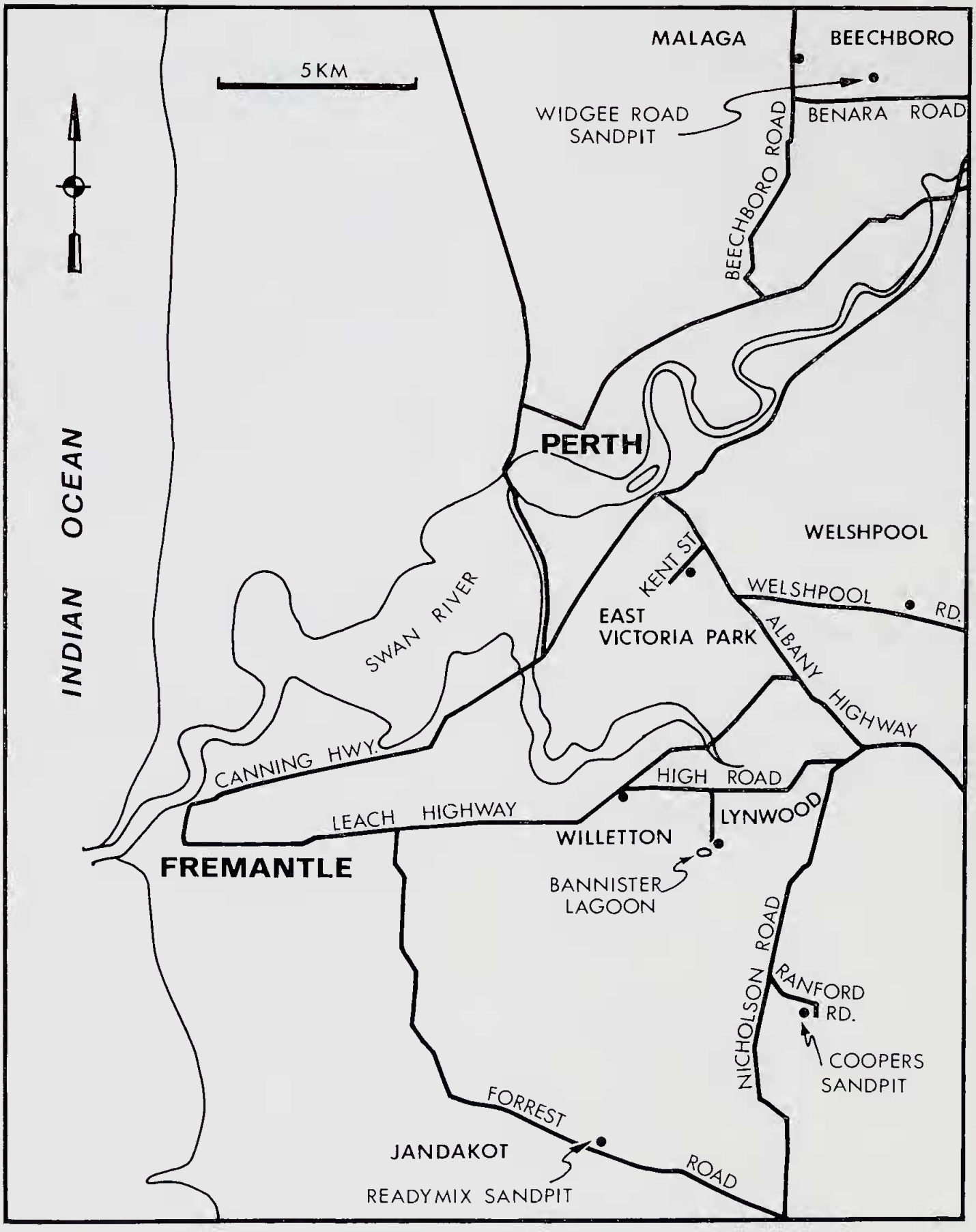

Fig. 2.—Map of Perth area showing fulgurite localities (small solid circles).

Fig. 3.—Wanneroo fulgurite (left) and two fragments from the Widgee Road Sandpit, Beechboro (centre and right). Note the holes in the Wanneroo material. The Widgee Road material has a smooth, shiny inner surface, and a rough outer surfacc with embedded sand grains. Length of Wanneroo tube 2.8 cm.

into glass, and the glass of the walls is finely vesicular. The mean refractive index of the glass ranges from 1.460 to 1.467 ± 0.002, but is most commonly within the range 1.461 to 1.463 ± 0.002. Dark glass from a parti-coloured fragment commonly though not invariably has a slightly higher refractive index than colourless glass from the same fragment.

The Wanneroo object, listed with the others below, is unique. It is an unflanged tube in which the lumen is smoother than the outer surface, but the clearly discernible sand grains characteristically embedded in the outer surface of other Western Australian fulgurites are not evident. The tube walls are unusual in containing a network of irregularly shaped holes up to 2 mm in diameter (Fig. 3).

The localities and main features of the newly recorded material are listed below.

Jandakot Lechatclicrite, Geology Dept. No. 73365

Locaiity: Jandakot Readymix Sandpit, Forrest Road (see Fig. 2).

No. of fragments: Two (includes one tube). Associated artifacts.

Colour: Very light grey (N8) to light grey (N7) with a few black (N1) spots.

Mean refractive index: 1.460 ± 0.002.

Lynwood Lechatelierite, Geology Dept. No. 73366

Locality: Sand blow-out north of Bannister Lagoon on Riley Road (see Fig. 2).

No. of fragments: One. Associated artifacts.

Colour: White (N9) to very light grey (N8) with a few black (N1) spots.

Mean refractive index: 1.461 ± 0.002.

Welshpool Lechatclierite, Geology Dept. No. 73367

Locality: Sand blow-out north side of Dowd Street near its eastern end, north of Welshpool Road (see Fig. 2).

No. of fragments: Two (includes one tube). Associated artifacts.

Colour: Light grey (N7) with a few biack (N1) spots.

Mean refractive index: 1.461 ± 0.002.

Malaga Lechatelierite, Geology Dept. No. 73368

Locality: Road cutting in sand, east side of Beechboro Road, 1.6 km north of King Road (see Fig. 2).

No. of fragments: One. Associated artifacts.

Colour: Pinkish grey (5YR8/1) with medium dark grey (N4) to black (N1) spots.

Mean refractive index: 1.461 ± 0.002.

Bcechboro Lechatelierite, Geology Dept. No. 73369

Locality: Disused sandpit, Widgee Road (see Fig. 2).

No. of fragments: 250, with numerous tubes (see Fig. 3). Associated artifacts.

Colour: Light grey (N7) to greyish black (N2).

Mean refractive index: 1.463 ± 0.002.

Upper Swan Lechatelierite, Geology Dept. No. 73545

Locality: 20 km N.N.E. of Perth, Bell Bros. Sandpit, northern side of Gnangara Road, 2.1 km west of West Swan Road turn-off. North of area covered by Figure 2, and not shown.

No. of fragments: Three. Associated artifacts.

Colour: Very light grey (N8) to light grcy (N7) with dark grey (N3) to black (N1) spots and streaks.

Mean refractivc index: 1.462 ± 0.002 with somc darker giass close to 1.464 ± 0.002.

Wanneroo Lechatelierite, C.S.I.R.O. No. 9073

Locality: Sand at Wanneroo, about 25 km north of Perth, precise locality not recorded.

No. of fragments: One tube.

Colour: Very light grey (N8) with rare small black (N1) spots.

Mean rcfractive index: 1.463 ± 0.002.

Guilderton Lechatelierite, Geology Dept. No. 73370

Locality: Sand blow-out near mouth of Moore River, south bank, opposite Guilderton (see Fig. 1).

No. of fragments: Five. Associated artifacts.

Colour: Greyish black (N2) to dark ycliowish brown (10YR4/2).

Mean rcfractive index: 1.461 ± 0.002.

Northampton Leehatelierite, Geology Dept. No. 73371

Locality: Sand blow-out 3 km west of Howatharra Homestead, which is 22 km south of Northampton on Highway No. 1 (see Fig. 1).

No. of fragments: One. Associated artifacts.

Colour: Dark grey (N3) to greyish orangc (10YR7/4).

Mean refractive index: Mainly close to 1.463 ± 0.002, but ranging from 1.461 to 1.467 ± 0.002.

Discussion

Some sandy areas of the Earth, such as the south-eastern portion of the Kalahari Desert in southern Africa, are notable for their concentration of fulgurites, and Lewis (1936) in his discussion of the region guessed that there were not less than 2,000 fulgurites within an area of about 20 sq km. He thought it reasonable, after questioning local inhabitants, to assume that the area had been struck recently only about once every fifty years by lightning. He therefore proposed that the sands might be about 100,000 years old, if there had been unchanged climate throughout.

Meteorologists chart thunderstorm activity by isobronts, lines that join places of equal annual thunderstorm activity. The central Perth Basin occupies a 20 to 30 isobront area, a thunderstorm frequency described by the Bureau of Meteorology (1967) as "relatively high", and exceeded in Western Australia only in the tropical northern part of the State. The Western Australian statistics suggest a far higher annual frequency of lightning in the central Perth Basin than that now experienced in the south-eastern Kalahari area, if the assumptions of Lewis are accepted. It should be added, however, that the isobrontic map of Ramakrishnan and Rao (1955) shows a higher thunder frequency in the Kalahari than around Perth. The Western Australian statistics suggest a far higher annual frequency of lightning in the central Perth Basin than that now experienced in the south-eastern Kalahari area, if the assumptions of Lewis are accepted. It should be added, however, that the isobrontic map of Ramakrishnan and Rao (1955) shows a higher thunder frequency in the Kalahari than around Perth.

Ten of the fourteen known Western Australian fulgurite localities are also rich in Aboriginal artifacts. There is not necessarily any significant connection between the association of artifacts and fulgurites: the former are normally sought in blown-out sandy areas because they are concentrated as wind removes the sand, and the fulgurite fragments, which are similarly concentrated, were found when the localities were examined for artifacts. The time of artifact manufacture in Western Australia ranges from the ethnographic present back 25,000 years and probably longer (see Dortch and Merrilees 1973). It is known, in the light of the West Popanyinning event, that fulgurites are forming at present, but it cannot be assumed that isolated fulgurite fragments are necessarily younger than the artifacts with which they were found. It is not possible to say what proportion of the recovered fulgurite material formed under the current climatic regime.

The recent spate of fulgurite finds in the Perth area, which is similar in its topography, sandy soil and meteorology to the surrounding region of the central Perth Basin, is probably a reflection of the high number of studied sites of former aboriginal occupation, rather than any special abundance of fulguritic material. Fulgurites are therefore probably fairly common throughout the central Perth Basin. Other sandy areas in Western Australia, such as the Gibson Desert and part of the Great Victoria Desert, are of equal isobrontic frequency, and the northern part of the Great Sandy Desert has a higher frequency. These areas will almost certainly contain numerous fulgurites.

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